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Transistor Devices Formulas

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List of 15 Transistor Devices Formulas

Transistor Devices

BJT

1) BJT Turn OFF Time

fx $T_{OFF} = T_s + T_f$ Open Calculator

ex $3.399\text{s} = 1.549\text{s} + 1.85\text{s}$

2) BJT Turn ON Time

fx $T_{ON} = T_r + T_d$ Open Calculator

ex $2.9\text{s} = 1.75\text{s} + 1.15\text{s}$

3) Power Loss in BJT

fx $P_{loss} = E_{loss} \cdot f_{sw}$ Open Calculator

ex $187.5\text{W} = 0.125\text{J} \cdot 1.5\text{kHz}$

4) Reverse Recovery Charge

fx $Q_{RR} = 0.5 \cdot I_{RR} \cdot t_{rr}$ Open Calculator

ex $0.040075\text{C} = 0.5 \cdot 35\text{mA} \cdot 2.29\text{s}$

5) Reverse Recovery Current

Open Calculator

fx $$I_{RR} = \sqrt{2 \cdot Q_{RR} \cdot \Delta I}$$

ex $$35.00857\text{mA} = \sqrt{2 \cdot 0.04\text{C} \cdot 15.32\text{mA}}$$

6) Reverse Recovery Time

Open Calculator

fx $$t_{rr} = \sqrt{2 \cdot \frac{Q_{RR}}{\Delta I}}$$

ex $$2.285155\text{s} = \sqrt{2 \cdot \frac{0.04\text{C}}{15.32\text{mA}}}$$

7) Softness Factor

Open Calculator

fx $$s = \frac{t_b}{t_a}$$

ex $$0.23511 = \frac{2.25\text{s}}{9.57\text{s}}$$

IGBT

MOSFET

8) Current Ripple Factor

Open Calculator

fx $$\mathrm{CRF} = \left(\left(\frac{\mathrm{I_{rms}}}{\mathrm{I_o}}\right) - 1\right)^{0.5}$$

ex $$0.894427 = \left(\left(\frac{90\mathrm{mA}}{50\mathrm{mA}}\right) - 1\right)^{0.5}$$

9) Input Current Distortion Factor

Open Calculator

fx $$\mathrm{CDF} = \frac{\mathrm{I_{s1}}}{\mathrm{I_s}}$$

ex $$0.5 = \frac{8\mathrm{mA}}{16\mathrm{mA}}$$

10) Input Current Harmonic Factor

Open Calculator

fx $$\mathrm{CHF} = \sqrt{\left(\frac{1}{\mathrm{CDF}^2}\right) - 1}$$

ex $$1.732051 = \sqrt{\left(\frac{1}{(0.5)^2}\right) - 1}$$

11) MOSFET Turn Off Time

Open Calculator

fx $T_{OFF} = T_{d\text{-}off} + T_f$

ex $3.4s = 1.55s + 1.85s$

12) MOSFET Turn ON Time

Open Calculator

fx $T_{ON} = T_{d\text{-}on} + T_r$

ex $2.899s = 1.149s + 1.75s$

13) Power Loss in MOSFET

Open Calculator

fx $P_{loss} = I_d^2 \cdot R_{ds}$

ex $187.425W = (105mA)^2 \cdot 17k\Omega$

14) Rectification Ratio

Open Calculator

fx $\eta = \frac{P_{DC}}{P_{AC}}$

ex $0.625 = \frac{25W}{40W}$

15) Voltage Ripple Factor

Open Calculator

fx $VRF = \frac{V_r}{V_{DC}}$

ex $0.333333 = \frac{5V}{15V}$

Variables Used

- **CDF** Input Current Distortion Factor
- **CHF** Input Current Harmonic Factor
- **CRF** Current Ripple Factor
- E_{loss} Energy Loss *(Joule)*
- f_{sw} Switching Frequency *(Kilohertz)*
- I_d Drain Current *(Milliampere)*
- I_o RMS Current DC Component *(Milliampere)*
- I_{rms} RMS Current *(Milliampere)*
- I_{RR} Reverse Recovery Current *(Milliampere)*
- I_s RMS Supply Current *(Milliampere)*
- I_{s1} RMS Supply Current Fundamental Component *(Milliampere)*
- P_{AC} AC Input Power *(Watt)*
- P_{DC} DC Power Output *(Watt)*
- P_{loss} Average Power Loss *(Watt)*
- Q_{RR} Reverse Recovery Charge *(Coulomb)*
- R_{ds} Drain Source Resistance *(Kilohm)*
- **s** Softness Factor
- t_a Forward Current Decay Time *(Second)*
- t_b Reverse Current Decay Time *(Second)*
- T_d Delay Time *(Second)*
- $T_{d\text{-}off}$ MOSFET OFF Delay Time *(Second)*

- $T_{d\text{-}on}$ MOSFET ON Delay Time *(Second)*
- T_f Fall Time *(Second)*
- T_{OFF} Turn OFF Time *(Second)*
- T_{ON} Turn ON Time *(Second)*
- T_r Rise Time *(Second)*
- t_{rr} Reverse Recovery Time *(Second)*
- T_s Storage Time *(Second)*
- V_{DC} DC Output Voltage *(Volt)*
- V_r Ripple Voltage *(Volt)*
- **VRF** Voltage Ripple Factor
- ΔI Change in Current *(Milliampere)*
- η Rectification Ratio

Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Electric Current** in Milliampere (mA)
  Electric Current Unit Conversion
- Measurement: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Electric Charge** in Coulomb (C)
  Electric Charge Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Frequency** in Kilohertz (kHz)
  Frequency Unit Conversion
- Measurement: **Electric Resistance** in Kilohm (kΩ)
  Electric Resistance Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion

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